WIRELESS CONTROL SYSTEM FOR MODERN HOUSE BOARD

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REMOTE RF CONTROL FOR HOME APPLIANCE DEVELOPMENT BOARD

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ABSTRACT

Modern house nowadays are becoming more advance as many innovation inventions are invented in a fast rate as technologies are rapidly increasing. Some of the features for the control system for modern house are mail notification, power saving, water saving and smoke detection. An RF control system for modern house consists of two parts; transmitter and receiver. The transmitter is operated as a remote control and the receiver receive data from transmitter and then control the device. The system used wireless as the medium between remote control and controlled devices. This project is design for modern house to create the appliance control, efficient control and security system for modern house.

ABSTRAK

Rumah moden sekarang ini menjadi lebih maju dan maju setelah banyaknya inovasi penciptaan tercipta dalam pembangunan teknologi yang pesat dan pantas. Sesetengah ciri-ciri sistem kawalan rumah moden ialah pemberitahuan mel, penjimatan kuasa, penjimatan air, dan pengesan asap. Satu sistem kawalan frekuensi radio untul mengawal rumah moden ini merangkupi dua bahagian iaitu “trannsmitter” dan “receiver”. “Transmitter” beroperasi sebagai alat kawalan jauh dan “receiver” menerima data daripada “transmitter” dan seterusnaya mengawal peralatan rumah yang berkaitan. Sistem ini tidak menngunakan wayar (wireless) sebagai medium antara alat kawalan jauh dan peralatan yg dikawal. Projek ini direka untuk menghasilkan kawalan peralatan, kawalan yang cekap, dan sistem keselamatan untuk rumah moden.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

With the development of civilization and the evolution of work and lifestyle, the role of home and its functions have change gardually. In ancient times, a home was considered as a shelter that could protect people from threats in the world, such as inclement weather and dangerous animals. It was a crude construction and humans lived there on a temporary basis. In argricaltural society, some new construction methods were invented which made the home more durable and solid than before. However, the level of comfort within the home was primotive due to limitations in building meterials and techniques, and in home appliances.

Stepping into industrial society, the home became private dwelling the served as living quaters for one family[1]. Homes were invariably well built and the living conditions of the inhabitants improved significantly thanks to deserve design of the buildings and abundant home appliances.

In the twentieth century, people sought to explore ways of creating autonomous and adaptive household appliances employing the emerging technologies and innovations. In the 1950s, home components were expected to have the ability to operate intelligently, undertaking the tedious domestic tasks. After several decades, this ruogh vision was developed and generalized into the concept of Smart Home.

Smart Home refers a domestic environment where all kinds of smart devices are continuously working to make the inhabitants' lives more comfortable[2]. According to Consumer Electronics Association (CEA), the smart home system

involves five fundamental segments, home automation, security and access control, multimedia entertainment, remote communication, and networking protocolsand regulations. These five elements can be intergrated to work together. The design of the Smart Home System applies knowledge to generate a flexible, comfortable,healthy and efficient environment that enhances the quality of residents' life.

1.2 Basic of remote control

A remote control is a component of an electronics device, most commonly a television set, DVD player and home theater systems originally used for operating the television device wirelessly from a short line-of-sight distance. Remote control has continually evolved and advanced over recent years to include Bluetooth connectivity, motion sensor enabled capabilities and voice control[3][4].

The main remote control technology used in the home is infrared. The signal between a remote control handset and the device it is controlling are infrared pulses, which are invisible to the human eye. The transmitter in the remote control handset sends out a pulse of infrared light when a button is pressed on the handset. A transmitter is often a light emitting diode (LED) which is built into the pointing end of the remote control handset. The infrared light pulse represents a binary code that corresponds to a certain command, such as (power on). The receiver passes the code to a microprocessor, which decodes it and carries out the command [5].

The remote control is usually contracted to remote. It is known by many other names as well, such as converter, clicker, power rod, the box, jingle stick, flipper, hoofer-doofer, the tuner, 'the zapper', the changer, or the button. Commonly, remote controls are Consumer IR devices used to issue commands from a distance to televisions or other consumer electronics such as stereo systems, DVD players and dimmers. Remote controls for these devices are usually small wireless handheld objects with an array of buttons for adjusting various settings such as television channel, track number, and volume. In fact, for the majority of modern devices with this kind of control, the remote contains all the function controls while the controlled

device itself only has a handful of essential primary controls. Most of these remotes communicate to their respective devices via infrared (IR) signals and a few via radio signals. Earlier remote controls in the 1970s used ultrasonic tones. Television IR signals can be mimicked by a universal remote, which is able to emulate the functionality of most major brand television remote controls.

1.3 Remote appliance control

Remote appliance contro is the idea of having a higher level of control over device, using the internet. A higher level of control means that a user has greater access to the device, granting the user more options of maintaining the device. When the television was created, the only method of control was to manually turn the dial. When a remote was invented, users increase their control over the television to include control at a visible range of the device. Control remotely over the internet further increases the approachability of a device.

It s also important to realize that with wireless devices becoming more and more popular, their effect on remote controlling needs to be taken into account. Because of the growing impact of wireless devices, this thesis covers their usage to control appliances remotely. This creates an even higher level of control by including the technology that society is adopting at a great rate. Figure 1.1 shows the example of home appliance that can controlled by RF system.

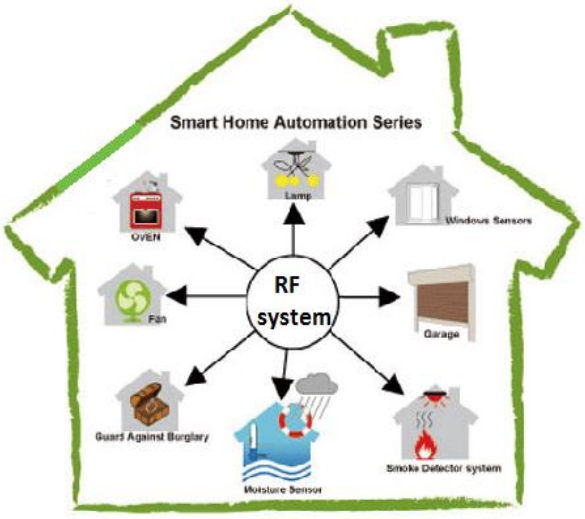

Figure 1.1 : smart home controlled by RF system

1.4 Objective

The main objective of this project is to design the remote RF control for home appliance development board. Home equipment can easily and effectively controlled by a remote RF control. By using this technology, it will reduce the cost of wiring the electric equipment, work more faster abd it also help disable person to do their work. There are 3 objective need to be achieved which are:

1. Study the RF system.
2. To developed hardware of wireless RF system.
3. Test the wireless RF system to the appliance related.

1.5 Scope of project

the scope of the project:

1. This remote RF control can be used to control home appliances within a range of 30 meters.
2. RF system module includes transmitter and receiver part. Transmitter (remote) operates using 9V battery. Receiver (bulb controller) operates using 240Vac power.
3. Transmitter module has a LCD to show system operation. There are 3 buttons on transmitter module used to control receiver module.
4. Receiver module is mainly used to receive transmitter command and control bulb brightness through TRIAC driver.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Most remote controls for electronic appliances use a near infrared diode to emit a beam of light that reaches the device. A 940 nm wavelength LED is typical. This infrared light is invisible to the human eye, but picked up by sensors on the receiving device. Video cameras see the diode as if it produces visible purple light.

With a single channel (single-function, one-button) remote control the presence of a carrier signal can be used to trigger a function. For multi-channel (normal multi-function) remote controls more sophisticated procedures are necessary: one consists of modulating the carrier with signals of different frequency. After the demodulation of the received signal, the appropriate frequency filters are applied to separate the respective signals. Nowadays digital procedures are more commonly used. One can often hear the signals being modulated on the infrared carrier by operating a remote control in very close proximity to an AM radio not tuned to a station.

Radio remote control (RF Remote Control) is a way to control distance objects using a variety of radio signals transmitted by the remote control device. By using radio remote control system, you can control a variety of mechanical or electronic devices to complete various operations, such as closing circuit, move handle, start motor, etc. As a complementary method to infrared remote control type, the radio remote control is widely used in garage door remote control, electric gate remote control, automatic barrier remote control, burglar alarm, industrial remote control and wireless home alarm systems.

2.2 Previous work on remote control

In the 1980s Steve Wozniak of Apple started a company named CL 9. The purpose of this company was to create a remote control that could operate multiple electronic devices. The CORE unit (Controller Of Remote Equipment) was introduced in the fall of 1987. The advantage to this remote controller was that it could “learn” remote signals from different devices. It had the ability to perform specific or multiple functions at various times with its built-in clock. It was the first remote control that could be linked to a computer and loaded with updated software code as needed.

The CORE unit never made a huge impact on the market. It was much too cumbersome for the average user to program, but it received rave reviews from those who could. These obstacles eventually led to the demise of CL 9, but two of its employees continued the business under the name Celadon. This was one of the first computer-controlled learning remote controls on the market.

2.3 Other remote control

Other remote control have been developed before. There some example of the other remote control.

2.3.1 ZigBee smart-home wireless

"ZigBee" derives from the ZigZag shapes dance which is created by the bees to exchange information of pollen location with the others. Because of the similar method of exchanging information, a new generation of wireless technology has been so named. ZigBee operates in licensefree 2.40HZ and 900MHZ band, with data rate ranging from 20kbps to 250kbps. Its network architecture with Master / Slave attributes, can achieve bi-directional communication. ZigBee technology is wireless networking protocol targeted towards home automation and remote control

applications. The ZigBee protocol consists of IEEE 802.15.4 standard and ZigBee standard, which describe the specification of PHY and MAC and Network and Application Lay, respectively.

IEEE 802.15.4 specification is used in ZigBee protocol as MAC and PHY standard. ZigBee wireless sensor network can adopt many types of network configuration. But each of them must contain coordinator node (gateway) and terminal node. The device in ZigBee network can be classified into three roles: coordinator, terminal device and router. The coordinator is a special FFD (full function device) which is used for achieving a lot of ZigBee services. The terminal device can be a FFD or RFD (reduce function device). A FFD can be used as anyone of the three roles, while a RFD can only act as the terminal device. Router is optional equipment of ZigBee which may be needed in some special network configuration.

2.3.2 Infrared (IR) remote control

Since infrared (IR) remote controls use light, they require line of sight to operate the destination device. The signal can, however, be reflected by mirrors, just like any other light source.

If operation is required where no line of sight is possible, for instance when controlling equipment in another room or installed in a cabinet, many brands of IR extenders are available for this on the market. Most of these have an IR receiver, picking up the IR signal and relaying it via radio waves to the remote part, which has an IR transmitter mimicking the original IR control.

Infrared receivers also tend to have a more or less limited operating angle, which mainly depends on the optical characteristics of the phototransistor. However, it's easy to increase the operating angle using a matte transparent object in front of the receiver.

2.4 Overview of remote RF control

A radio remote control system commonly has two parts: transmit and receive.

Transmitter part is generally divided into two types, namely, rf remote control and transmitter module, by the way of using, the rf remote control can be used independently as a whole while the transmitter module is used as a component in the circuit, the advantage of using transmitter model is it can be seamlessly connected with application circuit, and it's size is small, but users must have a knowledge of circuit to use the transmitter module, the rf remote control is much more easy to use at this point.

Receiver part also is generally divided into two types, namely, the super-regenerative receiver and the superheterodyne receiver, super-regenerative receiver is actually working like the regeneration of under intermittent oscillation detection circuit. While Superheterodyne type is working like the one in radio receiver. Superheterodyne receiver features stability, high sensitivity and the anti-interference ability is relatively good, while super-regenerative receiver features a small package and the price is also cheaper.

2.5 Different appliances

There are many different appliances that humans use every day. From the lamp to the refrigerator, there is an appliance for almost every situation of daily life. These different appliances can be categorized into three distinct types; simlpe, variable, and inventory. All three were developed for use in RACS and are explained in detail.

2.5.1 Simple appliances

A simple appliances has only two states, on and off. Such appliances are easy to control and require title interaction with a user. These are the most common appliances including such devices as a light and coffee maker. Modelling of this appliance means defining a simple control switch that turns the device on and off. The interface between the user and the device is, therefore, very simple.

2.5.2 Variable appliances

A variable appliance is a device that has a range of values, including off. These types of devices provide more funtionality and interaction with the user. A thermostat is such a device. It has a range of values that represent the temperature setting for a house. This type of appliances also has little interaction between the user.

2.5.3 Inventory appliances

An inventory appliances contains a listing of items associated with it. This would include appliances like a refrigerator. The appliance itself is has no real state like a simple or variable appliance, but contains a catalog of items that defines the appliance. There are more interaction between the user and such a device, as addition and deletion of items from the appliance is required.

2.6 House design

The most important aspect of the RACS is the idea of creating a relationship between the house and the appliances. The house, in the thesis, is the representation of a physical house containingg all appliances that could be controlled using RACS.

However, the concept of house could be applied to a school, office building, or laboratory.

The RACS house, like any other house, has any number of rooms and any number of appliances hook up inside those rooms. The RACS need to be able to allow the user to add and delete rooms from the house. Appliances could then be added into a given room. This concept of a house makes the logical connection to the physical involvement of appliances inside rooms.

2.7 Talking to appliances

Communication with devices is the main purpose of the RACS and is done through database interaction with variable and inventory appliances. Communication is simple and relies only on changing the attributes of entities represented in the database. For instance, to change the value of an inventory appliance, one needs to modify the value entry in the database corresponding to the user and a variable or inventory appliance.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In making this project, the I have used are computer software, laser printer, PCB developement tools, PCB assembly tools, and programing developement tools. There are some explanation how to use them.

3.1.1 Computer software

The computer is used to draw schematic and PCB for the system. Computer can be used to compile and download program into PIC through C-compiler and downloader software.

3.1.2 Laser printer

The laser printer is used to print the PCB drawing for PCB fabrication.

3.1.3 PCB development tools

The tools that used to developed a PCB are blade, fluorescence light, and PCB developer, etching poeder and thinner. Blade is used to cut suitable size for

PCB. Fluorescence light used to do photo etching for PCB. While PCB developer, etching powder and thinner used to develop track from PCB.

3.1.4 PCB assembly tools

To assemble the PCB, tools required are cutter, pliers, soldering iron, and mini drill. Cutter used to cut wire and components legs. Pliers used to bend component legs and place components on PCB. Soldering iron used to solder components on PCB. Mini drill used to drill holes on PCB to place components.

3.1.5 Programming development tools

In developing the programming, the tools used are PCW C-Compiler, Winpic800 USB Downloader Software, and Universal PIC Programmer.

PCW C-Compiler is used to edit and compile C-language program. It will generate .hex file for downloading application. The trial version of C-compiler can download from www.ccsinfo.com.

Winpic800 USB Downloader Software is used to download program to PIC. This software comes with Bizchip USB PIC programmer.

Universal PIC Programmer is an electronics device used to download PIC program into PIC. Through Winpic800 USB downloader software, this programmer can download PIC program (machine code, .hex file) into PIC. The programmer can buy from www.bizchip-components.com

3.2 Project workflow

To make this project done in time, I have made a workflow. This workflow guide me to do systematic work and I can do step by step. Figure 3.1 shown the project workflow.

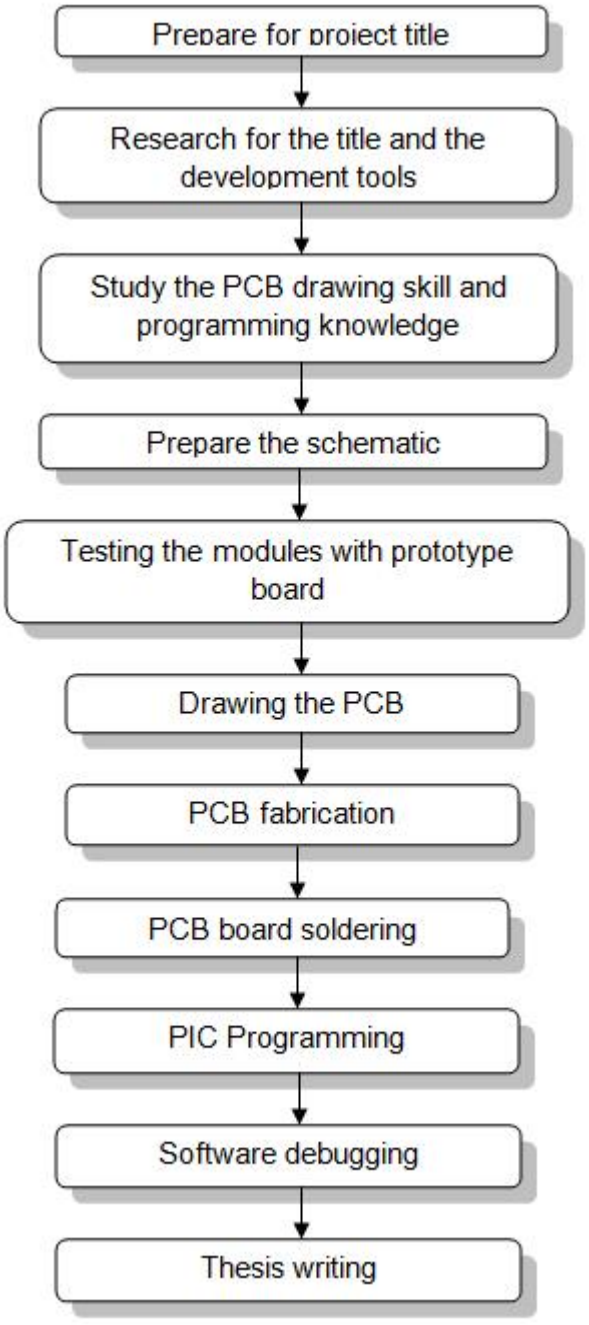

Figure 3.1: project workflow

3.3 Project development flowchart

Figure 3.2 shown the flowchart of project development.

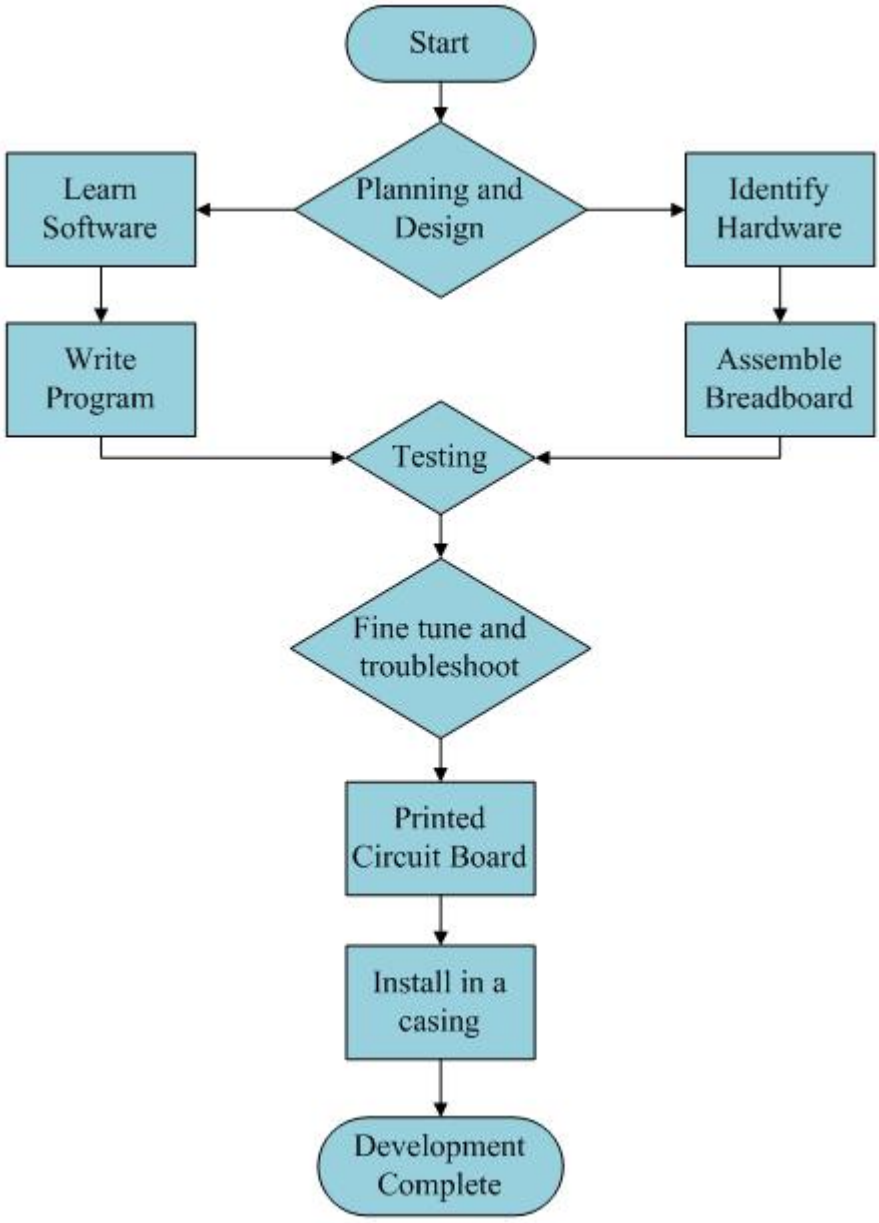

Figure 3.2: project development flowchart

A simple diagram of RF system to control home appliance are shown in figure 3.3. RF tramsmitter module and RF receiver module were implemented.

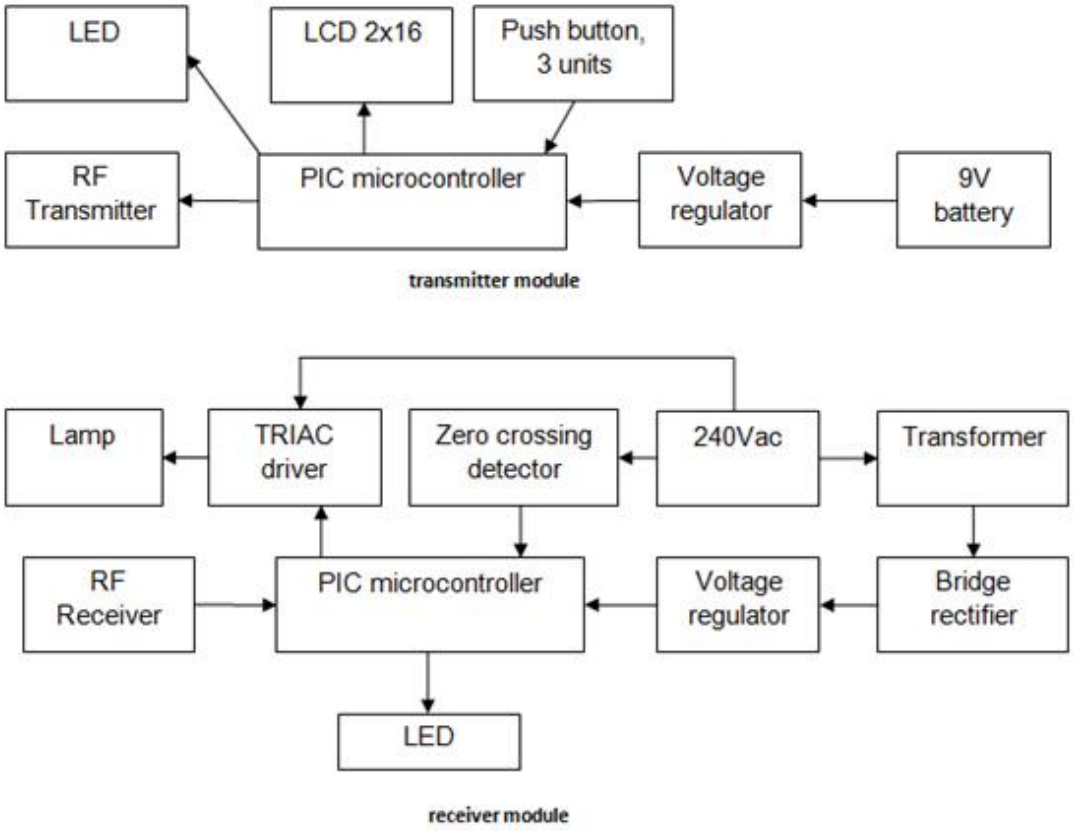

Figure 3.3: diagram of RF system to control home appliance

3.4 Microcontroller system board module

The main brain of the system is microcontroller PIC16F877A. There are many reasons I choose the controller to operate my patient module. It is designed using flash technology. So the PIC can read/write program for more than 100,000 times. The PIC 16F877A has 8 K words or program memory. Since each word in the midrange family is 14 bits long the program memory can also be expressed as 14 Kbytes. The unit has 368 bytes of data ram and 256 bytes of EEPROM. It has 8 channels of A/D with 10 bit resolution. The unit has 2 8 bit Timer/Counters and a single 16 bit Timer/Counter. In addition to this it has several different types of serial communication functions such as SPI, I2C, and normal pc type serial communications functions. Figure 2.2 shown the microcontroller PIC16F877A layout.

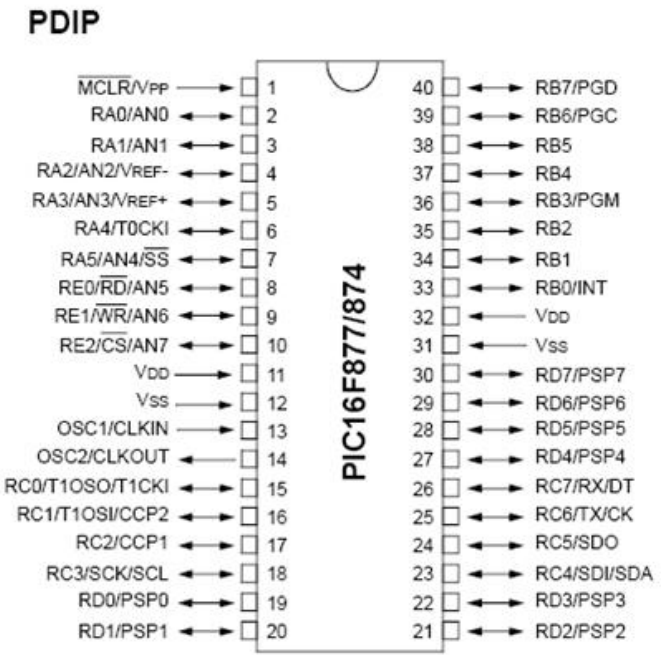

Figure 3.4: microcontroller PIC16F778A layout

OSC1 and OSC2 pins are connected to 20MHz crystal to execute every single program line in the system. 20MHz crystal is used because this is the maximum frequency that the PIC can support. If over frequency the PIC will burn. Else if crystal speed less than 20MHz then PIC response speed will slower. The MCLR pin of the PIC is pull up to 5V through a 10KR resistor.

The PIC can operate using 4.5V to 6.0V DC voltage. In the project is operating at 5.0V (by using 7805). It is DIP layout (dual in line package) and suitable for student project. It has 40 pins but only 33 I/O pins can be set as digital input or digital output. The digital output of the PIC is 5V (for signal 1) and 0V (for signal 0) these signals will be directly connected to actuators for control purpose. When the PIC pin is set as digital input, It will detect input voltage 5V as signal 1 and 0V as signal 0. Any voltage less than 0V or more than 5V will damage PIC.

3.5 Voltage regulator module

The voltage regulator module is used to protect PIC and other connected sensors / actuators from over voltage. This is because PIC and all other connected

sensors, actuators all support 5V DC only. Over voltage will cause any of the module burn. Figure 3.5 shown the circuit diagram of voltage regulator.

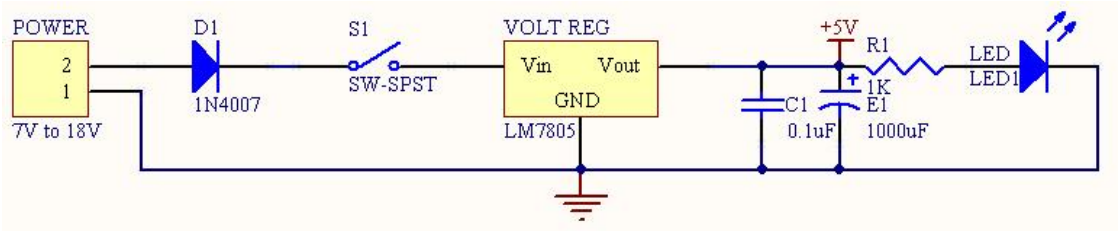

Figure 3.5: Voltage regulator circuit diagram

LM7805 is used to regulate voltage in the system and output 5V DC (max output current: 1000mA). It supports input voltage from 7V DC to 18V DC. If the input voltage is over, the LM7805 will burn or auto shutdown due to overheat.

The generated 5V from LM7805 will be noise filtered by 0.1uF ceramic capacitor and a 1000uF electrolytic capacitor. This is to avoid high frequency oscillation on the outputs which may cause system hang or unstable.

A diode is connected at the input of the LM7805. This is to avoid voltage connected reversely. An on/off switch is used to turn on/off the system and a LED (5V, 5mA) is used to indicate the system is power on/off. The LED is connected through 1KR resistor to limit current pass through LED is 5mA.

3.6 RF module

These RF modules are adopting RF integrated circuit with super-heterodyne working mode and SAW resonance. Its features are stability and strong ability of anti-jamming. It is widely used at some spot of industrial control that has high requirement. Figure 3.6 and 3.7 shown the RF transmitter module and RF receiver module.